

01-558

REMARKS

Claims 1-20 are in the case. The title is objected to. Claim 13 is rejected under 35 USC § 112. Claims 1-10, 13, and 16-20 are rejected under 35 USC § 102 over USPN 6,207,517 to Muller and claim 11 is rejected under 35 USC § 103 over Muller. Claims 12 and 15 rejected under 35 USC § 103 over Muller in view of USPN 6,285,057 to Hopper et al., and claim 14 is rejected under 35 USC § 103 over Muller in view of USPN 6,326,300 to Liu et al. Claims 1, 16, and 19 have been amended. No new matter has been introduced by the amendments, which are supported by the disclosure of the original claims and the specification. Reconsideration and allowance of the claims are respectfully requested.

TITLE OBJECTIONS

The title is objected to. Applicants respectfully traverse the objection. The hard mask *is not* selectively removed, as would be indicated by the title suggested by the examiner. Instead, the hard mask is completely removed. Thus, the title *Hard Mask Removal* is descriptive of the method according to the invention. Reconsideration and removal of the objection are respectfully requested.

CLAIM REJECTIONS UNDER §112

Claim 13 is rejected under 35 U.S.C. 112. Claim 13 recites that the underlying layer is a gate insulation layer and the patterned layer is a gate electrode layer. The examiner states that he does not understand how the patterned layer could function as a hard mask and a gate electrode. There appears to be some confusion. The patterned layer, regardless of what function it may ultimately or intermediately serve in various embodiments, is not the same layer as that which is referred to as the hard mask layer in the claims. The hard mask layer and the patterned layer are two separate and distinct layers. The hard mask layer is formed on an upper surface of the patterned layer. Thus, the question as to how the patterned layer could function as a hard mask and a gate electrode appears to be irrelevant, because claim 13 does not affirmatively recited that the

01-558

patterned layer performs both functions. Reconsideration and allowance of claim 13 are respectfully requested.

CLAIM REJECTIONS UNDER §102

Claims 1-10, 13, and 16-20 are rejected under 35 U.S.C. 102 as being unpatentable over Muller. Independent claim 1 claims, *inter alia*, a method of removing a hard mask layer from an upper surface of a patterned layer, which is formed over an underlying layer, where the hard mask layer is removed using an etchant that detrimentally etches the underlying layer when the underlying layer is exposed to the etchant for a length of time typically required to remove the hard mask layer, without detrimentally etching the underlying layer. A modification is performed *on all of the hard mask layer* that is remaining on the upper surface of the patterned layer at the time when the modification is accomplished, without modifying portions of the underlying layer that are to remain, without modifying portions of the underlying layer that are to remain, so that the hard mask layer is etched by the etchant at a substantially faster rate than that at which the etchant etches the underlying layer in the unmodified portions that are to remain, patterning the hard mask layer to expose portions of the patterned layer, etching the patterned layer to expose portions of the underlying layer that are to be removed, and etching both the hard mask layer and the exposed portions of the underlying layer with the etchant, where the etchant etches the hard mask layer at a substantially faster rate than that at which the etchant etches the unmodified portions of the underlying layer, because of the modification of the hard mask layer.

Thus, the current process is much different from that as described by Muller. In the present process as claimed, several different elements in combination are required, which elements are not describe by Muller. For example, the present invention as claimed requires *three layers that are disposed in a specific arrangement*: there is a bottommost layer that is called the underlying layer, a topmost layer that is called the hard mask layer, and a patterned layer that is disposed between the underlying layer and the hard mask layer. Muller does not describe these three layers. *Muller describes at most two adjacent oxide layers*, one which may be a low temperature oxide and the other which may be a thermal oxide. However, Muller does not describe an intervening

01-558

patterned layer, as required in claim 1. This is a first patentable difference between claim 1 and Muller.

The current process as claimed recites that *all of the remaining hard mask layer receives a modification*. However, Muller describes that the oxide layer is selectively implanted. Muller describes that more than one selective implantation may be performed, but all *the implantation described by Muller are selective*, and are not performed on all of the remaining layer, as recited in claim 1. This is a second patentable difference between claim 1 and Muller.

For these and other reasons, claim 1 patentably defines over Muller. Reconsideration and allowance of claim 1 are respectfully requested. Dependent claims 2-10 and 13 depend from independent claim 1, and contain additional important aspects of the invention. Therefore, dependent claims 2-10 and 13 patentably define over Muller. Reconsideration and allowance of dependent claims 2-10 and 13 are respectfully requested.

Similar to that are described above in regard to claim 1, claim 16 claims, *inter alia*, a sequential method of using a hard mask layer to pattern a patterned layer formed over an underlying layer, where the hard mask layer is removed using an etchant that detrimentally etches the underlying layer when the underlying layer is exposed to the etchant for a length of time typically required to remove the hard mask layer, without detrimentally etching the underlying layer. The hard mask layer is formed over the patterned layer, modifying all of the hard mask layer that is remaining on the patterned layer at a time when the modifying is accomplished, without modifying portions of the underlying layer that are to remain, so that the hard mask layer is etched by the etchant at a substantially faster rate than that at which the etchant etches the underlying layer in the unmodified portions that are to remain, patterning the hard mask layer to expose portions of the patterned layer, etching the patterned layer to expose portions of the underlying layer that are to be removed, and etching both the hard mask layer and the exposed portions of the underlying layer with the etchant, where the etchant etches the hard mask layer at a substantially faster rate than that at which the etchant etches the unmodified portions of the underlying layer, because of the modification of the hard mask layer.

01-558

As described above, Muller does not describe this combination of elements. Thus, claim 16 patentably defines over Muller. Reconsideration and allowance of claim 16 are respectfully requested. Dependent claims 17-18 depend from independent claim 16, and contain additional important aspects of the invention. Therefore, dependent claims 17-18 patentably define over Muller. Reconsideration and allowance of dependent claims 17-18 are respectfully requested.

Similar to that are described above in regard to claims 1 and 16, claim 19 claims, *inter alia*, a sequential method of using a hard mask layer formed over a patterned layer to pattern the patterned layer formed, which is formed over an underlying layer, where the hard mask layer is removed using an etchant that detrimentally etches the underlying layer when the underlying layer is exposed to the etchant for a length of time typically required to remove the hard mask layer, without detrimentally etching the underlying layer. The hard mask layer is formed over the patterned layer, patterning the hard mask layer, etching the patterned layer to expose portions of the underlying layer that are to be removed, modifying all of the hard mask layer that is remaining on the patterned layer, without modifying portions of the underlying layer that are to remain, so that the hard mask layer is etched by the etchant at a substantially faster rate than that at which the etchant etches the underlying layer in the unmodified portions that are to remain, and etching both the hard mask layer and the exposed portions of the underlying layer with the etchant, where the etchant etches the hard mask layer at a substantially faster rate than that at which the etchant etches the unmodified portions of the underlying layer, because of the modification of the hard mask layer.

As described above, Muller does not describe this combination of elements. Thus, claim 19 patentably defines over Muller. Reconsideration and allowance of claim 19 are respectfully requested. Dependent claim 20 depends from independent claim 19, and contains additional important aspects of the invention. Therefore, dependent claim 20 patentably defines over Muller. Reconsideration and allowance of dependent claim 20 are respectfully requested.

01-558

CLAIM REJECTIONS UNDER §103

Claims 11-12 and 14-15 are rejected under 35 U.S.C. 103(a). Claim 11 is rejected over Muller, claims 12 and 15 are rejected over Muller in view of Hopper et al., and claim 14 is rejected over Muller in view of Liu et al. Claims 11-12 and 14-15 all depend from claim Independent claim 1, and therefore claim *inter alia*, a method of removing a hard mask layer from an upper surface of a patterned layer, which is formed over an underlying layer, where the hard mask layer is removed using an etchant that detrimentally etches the underlying layer when the underlying layer is exposed to the etchant for a length of time typically required to remove the hard mask layer, without detrimentally etching the underlying layer. A modification is performed *on all of the hard mask layer* that is remaining on the upper surface of the patterned layer at the time when the modification is accomplished, without modifying portions of the underlying layer that are to remain, without modifying portions of the underlying layer that are to remain, so that the hard mask layer is etched by the etchant at a substantially faster rate than that at which the etchant etches the underlying layer in the unmodified portions that are to remain, patterning the hard mask layer to expose portions of the patterned layer, etching the patterned layer to expose portions of the underlying layer that are to be removed, and etching both the hard mask layer and the exposed portions of the underlying layer with the etchant, where the etchant etches the hard mask layer at a substantially faster rate than that at which the etchant etches the unmodified portions of the underlying layer, because of the modification of the hard mask layer.

The deficiencies of Muller in regard to this combination of limitations are described at length above. Thus, claim 11 patentably defines over Muller. Reconsideration and allowance of claim 11 are respectfully requested.

Neither Hopper et al. nor Liu et al. compensate for the deficiencies of Muller, in that neither Hopper et al. nor Liu et al. are sufficient to modify Muller to include the three layers in the arrangement and configuration as claimed, or to modify Muller to perform a blanket implant on all of the remaining hard mask so that it is completely removed. Therefore, dependent claims 12 and 14-15 patentably define over the cited combinations of references. Reconsideration and allowance of dependent claims 12 and 14-15 are respectfully requested.

01-558

CONCLUSION

Applicants assert that the claims of the present application patentably define over the prior art made of record and not relied upon for the same reasons as given above. Applicants respectfully submit that a full and complete response to the office action is provided herein, and that the application is now fully in condition for allowance. Action in accordance therewith is respectfully requested.

In the event this response is not timely filed, applicants hereby petition for the appropriate extension of time and request that the fee for the extension be charged to deposit account 12-2355. If other fees are required by this amendment, such as fees for additional claims, such fees may be charged to deposit account 12-2252. Should the examiner require further clarification of the invention, it is requested that s/he contact the undersigned before issuing the next office action.

Sincerely,

LUEDEKA, NEELY & GRAHAM, P.C.

By: 

Rick Barnes, 39,596

2005.05.16